A Photographic Study of the Region of the Great Nebula in Orion.

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Kelvin Burns

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C O N T E N T S

THE COLOR OF THE STARS IN THE GREAT NEBULA OF ORION.

In order to determine the color of the stars in the Great Nebula in Orion and by this means to draw some conclusions as to their spectral type four plates of the region were taken with the Crossley Reflector, two on Seed 27 plates and two on plates treated with the Wallace three dye stain*. A yellow screen was used in taking the latter plates. This screen weakens $H\beta$ and transmits very little light of wave length less than $H\beta$. The relative intensity below 5000 is not greatly affected by the screen.

The ordinary plates were exposed 5 minutes and 1/2 minute; the corresponding stained plates 54 minutes and 5 minutes. The stars are of nearly equal mean intensity on corresponding plates, but the nebula of course changes considerably in extent and in the relative intensity of its parts in going from the ordinary to stained plates. It might be said in passing that the 54^m exposures show a wealth of detail and a sharpness of outline in the nebula never found on ordinary plates taken with the same instrument, suggesting the possibility of an advantage in using screens in the study of nebular changes.

A region 30' square having the Trapezium as center was examined and all those stars discussed which show on either ordinary plate and its corresponding stained plate. The images were compared with a magnitude scale on which

* W. W. Campbell, L. O. Bulletin 5, 151.

the images were numbered consecutively, beginning with the brightest, and each star was estimated to be a certain number of tenths of a grade fainter than one of the images on the scale. Then after making the mean estimated brightness the same for stars of magnitude 7 to 9, 9 to 11 and so forth on each of corresponding red and blue plates the differences in scale value were taken for each star. These differences were reduced to magnitudes by employing the factor $0^m.4$ found by platting the magnitudes against the scale values for such of the comparison stars for T Orions as are found in the region discussed. In the case of the Lyra field to be discussed presently the stars fainter than 11^m are reduced in essentially the same manner while those brighter than 11^m are reduced in such a way that the color of A type stars is zero, while that of Ma type is $+2^m.0$. This was possible because three stars whose spectra are known occur on the plates discussed, one each of type A, F, Ma.

A glance at the plates of the Orion region is sufficient to show that the stars involved in dense nebulosity are relatively brighter on the stained than on the ordinary plates. It is hardly possible that this is all due to the effect of the darkening of the plate by the nebulosity, as the intensity of the dense parts of the nebula is much the same on corresponding plates, and of course the greater part of the region observed shows no nebulosity on any of the plates discussed.

Since the presence of nebulosity seemed to affect

the color of the stars it seemed necessary to consider this effect in drawing any conclusions from the color of individual stars. The stars were divided into three groups, the first containing those brighter than $11^{m}.4$, the second those between $11^{m}.4$ and $13^{m}.5$, the third, the remaining stars. It must be remembered that this last group is defective in that many stars that should occur in it are missing on the ordinary plate. Each of these groups was sub-divided as follows; an ordinary plate of moderate density was used to classify each star according to the density of the nebulosity surrounding it on this plate. Each star was noted as being in a region free from nebulosity, or surrounded by faint, moderate or dense nebulosity. The results of this classification are seen in Table 1. under "color" the plus sigh indicates that the stars of the group with which it is used are brighter by the indicated number of hundredths of a magnitude on the stained than on the ordinary plate.

TABLE 1.

Nebulosity	None			Faint		
Magnitude	<11.3	11.4 to 13.5	>13.5	<11.3	11.4 to 13.5	>13.5
Color	-06	-07	-21	+08	-10	-29
Number of Stars	32	48	23	8	22	9

TABLE 1.

Nebulosity	Moderate			Dense		
Magnitude	<11.3	11.4 to 13.5	>13.5	<11.3	11.4 to 13.5	>13.5
Color	+19	+20	-15	+60	+42	>+40
Number of Stars	8	21	6	6	20	---

The bluest star in the regions of dense nebulosity is only $-0^{m}.04$, and we might expect to find a few blue stars in these regions that were between us and the nebula, if the redness of stars in the nebulosity is due to absorption. The explanation may lie in the fact that even the Orion stars in the densest nebulosity are quite blue and that any stars which may be between us and the nebula are not exceptionally blue. There may be no Orion stars so far this side the nebula as to be entirely free from it.

It may be that the type of star in the dense nebulosity is somewhat different from that of those just outside. But it seems that the natural explanation of the results shown in Table 1 is to suppose the nebula absorbs the light of the stars involved in it and absorbs the violet rays more strongly than the red. If this is the case it should be rather easy to determine whether the absorption is due to the bands of a gas or is the result of diffraction by minute particles. An attempt will be made to determine the nature of the absorption as soon as the field can be observed.

Thirteen variable stars and six suspected variables were examined and found to be about the same color as other stars in the same part of the field. After correcting for the effect of the surrounding nebulosity the mean color of the nineteen stars is zero, showing them to be blue and therefore probably short period variables. Plates taken on the same night tend to add weight to this assumption.

The field observed is too small to give a great deal of weight to general conclusions as to the distribution of the stars, but it is very noticeable that regions free from nebulosity on a dense plate contain comparatively few stars. An examination of the stars in these regions showed them to have the same mean color as the mean of the stars in the first six columns of Table 1.

It is impossible to avoid the conclusion that faint stars are more numerous in the edges of regions of dense nebulosity than on the plate as a whole and that they are comparatively red. The very densest parts of the nebula probably blots out many such stars.

In Table II the stars are grouped by magnitudes in columns and by color in the lines. As in Table I, the stars in the columns headed by the positive sign are brighter on the stained plate by the indicated number of tenths of a magnitude. Thus under Orion A the third line from the top shows that of the stars in this region between the 12th and 13th magnitudes, four are redder than $+0^{m}.6$, 9 between $+0^{m}.4$ and

+0^m.6, and so forth, none being bluer than-0^m.6. Under Orion A the stars of this region are tabulated as observed, while under Orion B they are tabulated after correction for surrounding nebulosity. The faint stars are ommitted in all cases under the heading "All". In the discussion of the types the stars are limited to those brighter than 13^m.3in the Orion region and brighter than 14^m.0 in the Lyra region.

TABLE II.

ORION A.

B.-R. Mag	>+.6	+.4 to+.6	+.2 to +.4	+.2 to.0	0 to-.20	-.20 -.40	-.40-.60	<-.60
<11	3	3	7	14	11	1	1	1
11-12	0	5	5	10	10	5	1	0
12-13	4	9	7	11	14	8	2	0
Faint	0	3	9	11	18	19	6	1
All	9	17	15	28	38	26	4	1

ORION B.

<11	2	0	9	10	13	8	2	1
11-12	0	0	8	12	9	5	0	0
12-13	1	2	11	19	17	11	4	1
Faint	0	1	6	16	24	12	3	3
All	3	2	28	41	39	17	4	1

LYRA

<11	3	1	1	2	2	2	1	0
11-12	3	4	2	1	1	6	1	2
12-13	1	2	2	3	3	3	2	1
13-14	6	7	7	13	16	15	5	2
Faint	0	0	1	17	16	4	0	0
All	13	14	12	19	22	26	9	5

In both fields the number of stars was limited by the blue plate so that we would not expect to find any very red stars in the faint group. The lack of faint blue stars in the Lyra region may be only apparent and caused by the observer calling all objects near the limit about the same mag-

nitude, or there may be no faint blue stars in this region.

If the stained and ordinary plates had been reduced by curves having the same slope, and if the mean magnitude was made to agree at 10^m then the mean $13^m.5$ star on the red plate would be 14m0 on the blue plate in the lyra region and $14^m.2$ in the Orion region. This may be due wholy or in part to the manner of taking and manipulating the plates. In future work stained plates will be exposed without the screen, using a sector diaphragm to lengthen the exposure to that required when the screen is used, and the two sets of plates developed together. In this way some of the factors of uncertainty will be eliminated, but still a change in the mean color of stars fainter than those types we know must be regarded with suspicion when found in this manner.

In the Lyra field the mean stars of Type A brighter than 11^m should have color ±0; fainter than 11m the mean type A star is probably $-0^m.1$ or $-0^m.2$. The redness increases $+0^m.5$ per type so that stars of Type Ma would be $+2^m.0$ if brighter than 11^m and $+1^m.8$ if fainter. Thus there are probably in the region considered in Lyra (roughly 20' Square) two or three stars of Type K, ten or eleven of Type G, some 25 of Type F, 65 of Type A and fifteen of Type B or other blue stars. The nebular star is $-1^m.2$, no other star is bluer

Professor King, H.C.O. Annals 59, 126 finds a difference of 0.4 per type in the photographic-visual magnitudes.

than -0.8. The probable error of a color determination in the Lyra region is somewhat less than ±0m.1. Owing to the use of fewer plates it is somewhat greater in the Orion region so we might expect more large difference in magnitude but Table II shows that this is far from being the case.

θ_1 type O6.5, θ_2 type B1 and Bond 905, B3 are $+0^m.2$, $-0^m.1$ $0^m.0$ respectively when corrected for nebulosity, +0m.6, +0.3 and $-0^m.1$ uncorrected. The photographic-visual* is +.1, -0.3 and -.5, which agrees roughly with the uncorrected color after applying a constant correction. So it seems that zero color must correspond to a B type star in this region. On this assumption there can be no more than one star in the region having a spectrum as advanced as G, only five that can be F and about thirty that may be either A or B, while some eighty stars are almost certainly between Oe and B8. Since the stars of color 0.0 to -0.4 would be likely to be largely A type in an average region of the sky, it may be that the group we have assumed to be B type contains a large number of A type stars and that each group to the red is one stage more advanced than we have supposed. On this supposition there may be more stars of type F, but there is very little probability of more than one solar star. There are only five stars bluer than $-0^m.6$. One of these is Bond 554, a $9^m.0$ star whose color is $-0^m.8$ in the mean of two independent determinations. It is situated in a region almost free from nebulosity on the

*H. C. O. Annals. 50.

densest plates. While it is not a recognized variable its apparent color may be due to rapid variability as the plates were an hour apart. Several of the differences may be due to varability.

The following is a list of the stars observed in the region of the Ring Nebula in Lyra. The magnitudes depend on those published in the Astronomical Journal Vol. 26, 108. The first column of this table contains a number used by Professor Leavenworth in his work on this field, and will serve as the means of obtaining the R.A. and Decl of the stars. Column 2 contains the photometric magnitudes copied from the article mentioned above. Columns 3 and 4 contain the magnitudes observed on the red and ordinary plates respectively.

Magnitudes of Stars in the Region of Messier 57.

Leav No	Vis Mag	Red Mag	Blue Mag
2		1262	36
2		1259	39
3		1320	70
4		1405	1383
5		1135	90
6		1369	99
7		1350	64
8		1378	87
9		1350	35
10		1268	37
11		1344	1285
12		1162	1233
h	1190	1187	58
1	1247	1259	39

Magnitudes of Stars in the Region of Messier 57.

Leav No	Vis Mag	Red Mag	Blue Mag
f	1158	1114	1059
k	1201	1184	1235
14		1305	65
15		1379	65
16	1078	1063	1119
17		1414	17
18		1418	1399
19		1357	62
20		1414	14
21		1326	11
22		1341	85
23		1414	11
24		1341	00
24'		1405	09
22'		1421	07
25		1232	79
26		1159	19
27		1403	1384
28	1054	1047	38
29		1168	1235
30		1388	65
31		1300	02
32		1274	98
33		1446	39
33		1441	45
34		1374	1417
34'		1421	1384
35		1384	70
36		1308	1401
37		1384	88
38		1389	1413
39	1084	1081	71
39'		1432	25
40		1338	1292
41		1347	27
42	1262	1235	1366
43		1390	84
44		1199	31
45		1285	45
46		1335	99
48		1405	10
49		989	1135
51		1396	59
52		1347	35

Magnitudes of Stars in the Region of Messier 57.
Continued..

Leav No	Vis Mag	Red Mag	Blue Mag
53		1402	1366
54		1341	98
55	1239	1244	14
56	1147	1148	08
57		1441	22
b		1460	56
c		1450	41
d		1423	24
f		1418	45
f		1432	20
f		1382	14.8
k		714.5	14.7
p		1460	60
Neb 1		1432	1316
Neb 2		1473	49
58		1350	26
59		1429	22
60	1077	1094	61
61		1344	56
62		1423	33
63		1341	17
64	1189	1187	1202
65		1175	1223
66		1382	96
67		1375	1414
68		1358	25
69		1405	22
70		1372	82
71		1411	17
72		1387	91
73	1268	1262	85
74		1247	63
75		1338	01
76		1287	47
77		1365	82
78		1150	43
79		1329	25
80		1393	77
81		1305	1260
82		1396	93
83		1293	1368
84		1371	60

Magnitudes of Stars in the Region of Messier 57
Continued.

85	1234	1356	1297
85'		1256	74
86	1110	1108	34
87		1332	78
88		1347	97
89	1075	1060	65
90		1413	1386
New 1		1423	1390
" 2		1438	54
" 3		1344	1424
" 4		1268	14
91	1187	1177	16
92		1432	22
94		1378	1420
95		1420	27
96	1214	1202	62
97	1068	1078	1136
99		1347	64
101		1326	1289
101'		1411	10
103		1339	1264
104		1235	94
105		1393	1414
106		1429	23
106'	1001	1039	76
107		1369	35
108'		1405	1389
109	993	982	1075
109'		1362	41
109		1378	56
110		1166	42
111		1396	84
112		1393	69
113		1168	1229
114		1402	1398
115		1365	91
116		1317	1253
117	1179	1187	03
118		1389	1419
119		1408	00
120		1419	22
121		1387	79
122		1356	27
123	1189	1201	1134
124		1369	32

Magnitudes of Stars in the Region of Messier 57
Continued.

125	1060	1055	62
126		1173	1203
128		1141	1206
129		1409	10
130		1423	12
131		14.5	1444
132		1378	85
132'		1337	1288
133		1383	76
134		1323	1286
135		1383	71
136		971	1033
137		1318	98
B19	1108	1093	1159
B20	842		
B23	846		
B24	957		

P A R T II.

List of Variable Stars Observed.

Bond No	R.A 1900	Decl 1900	Max	Min
435	5 29 46	-5 26 46	12.4	13.1
467	29 53	38 16	8.0	8.7
506	30 01	27 15	11.4	12.0
510	02	35 37	12.6	13.3
524	06	27.02	12.6	12.9
545	09	34 01	12.6	13.3
558	11	29 21	11.4	12.0
573	16	30' 3	12.0	12.6
581	16	30 0	12.5	13.0
589	18	28 0	12.2	13.2
615	21	19.0	13.2	13.8
663	25	24.9	12.6	13.6
685	28	28 55	6.0	8.0
708	32	2859	7.4	8.1
709	32	29.6	118	126
741	37	29 12	8.7	9.3
759	41	25 23	126	137
784	47	32 08	111	119
801	51	32.0	129	139
822	56	32 28	9.9	10.3
832	5 30 58	-5 27.6	126	137

Under maximum and minimum are given the mean from two accordant plates excepting in case of 506, 589, 685, 801.

Notes

435, 663, 709, 759, 784, 822 are known variables. 589 is marked "var?" by Parkhurst. It is found in the second catalogue of variable stars. The nebulosity in its neighborhood makes the present estimates of small value.

524 and 558 have been suspected of variability. These measures confirm the variability of the second.

801, announced by Bond as variable, but not in the Second Catalogue, is certainly variable. It is moderately bright on most plates and entirely absent on other excellent plates showing stars half a magnitude fainter than it is ordinarily.

506 is suspected of variability, but most of it's range depends on one plate. 685 and 708 are too bright and too much involved in nebulosity to make certain of their variability. The latter is probably variable, the former may be. On some plates they appear of equal intensity, while on others there is two magnitudes difference between them. 510 and 545 have equal magnitude on all 8 plates.

573 and 581 appear sometimes of equal intensity while at other times one is nearly a magnitude brighter than the other. The nebulosity prevents the most accurate estimates of their magnitude, but one at least must be variable.

467, 510, 545, 558, 615, 741, 832, only two of which have been previously suspected of variability are certainly variable.

P A R T I I I.

Proper Motions in the Region of the Great Nebula in Orion.

It was hoped at the beginning of this undertaking that it would be possible to derive the parallax and proper motion for several points on the Nebula, and for about 100 stars. It was found on examining the plates on hand that only the proper motions could be determined on account of the lack of good fall plates. The work was carried through for the proper motions of some 15 points on the Nebula and all the stars that could be measured in a square 20' on a side having the Trapezium as center. Four plates whose mean epoch is 1897.69 and four whose mean epoch is 1908.93 were used. In addition the brighter stars were measured on an early and a late plate of only 2^m exposure. As the former was poor the results from it are of little value and it was used only in case of the Trapezium. The results from the latter were used with the other four plates for those stars measured on it. The average exposure time is one hour . These plates were taken by Professor Leavenworth with the

10 1/2 inch telescope of the Observatory. The late plates were taken with the aperture reduced to 10 or 9 1/2 inches, to give a wider field. With full aperture the effect of distortion begins to be noticeable at a distance of 15' from the center of the field. With the exception noted the images are good on all the plates used. The scale is 1mm = 1'.

The plates were measured in four positions on a Repsold Measuring Engine. Each plate was put into the machine in the same position so that each star was always connected with the same scale division. And as each star was always measured with the same part of the micrometer screw it was unnecessary to correct for division error or error of run, the latter being small and quite constant throughout the set of measures. The pitch of the micrometer screw is $0^{m}.5$. Artificial light was used to illumine the plates. The microscope enlarges 10 diameters.

A least square solution of the equations resulting from the measures of 33 stars was used to reduce all plates to the scale of plate #60. Six constants were found for all plates except numbers 8 and 219, on which only 16 stars were available for the reduction, the normal equations differ only in the absolute terms. After reducing the plates to the same scale in this manner the means of the first group was subtracted from that of the second group for each star. The difference divided by the mean interval, 11.3, is taken for the yearly

proper motion. The probable error of the proper motion was computed as follows:

The probable error of the mean of each group was computed for each star from the residuals of the individual plates, and the p. e. of the difference was computed from the p. e. of the means. The p. e. of the yearly μ is about $\pm 0''.007$ for the stars of magnitude 10 and 11, but increases to nearly double that in case of both the faint and bright stars.

It was found that the proper motions so determined was affected by a decided magnitude equation, so each plate was solved graphically for this quantity. About half the plates were affected by an equation which seemed to be liniar. Accordingly the P.M. in X & Y was solved and corrected for this effect. This comes to the same end as correcting each plate for magnitude equation and retaking the means, since the equation was liniar in every case.

The probable error of the proper motions of points on the Nebula are very much larger than those deduced for the stars so that it is not thought that any great confidence can be put in the results for a single point. A point whose p. e. is $\pm 0''.027$ was given weight unity and the weighted mean of all points observed was taken as the proper motion of the Nebula. The results are $\mu = -0''.014 \pm 0''.014$, $\mu' = +0''.015$ $0''.013$ So there is no measurable motion of the Nebula with respect to the stars in the field. By platting the amount and direction of the motion of each point nothing systematic, such as

a whorl or expansion was found.

The plates were not at all suited to the measurement of the Trapezium and $\theta 2$. Using the mean result of the four stars of the Trapezium we get

$\mu = \pm 0''.000 \pm 0''.007$ $\mu' = -0''.012 \pm 0''.007$

For $\theta 2$.

$\mu = +0''.018 \pm 0''.035$ $\mu' = +0''.012 \pm 0''.030$

Thus little is learned from these measures as to whether the bright stars and Nebula have the same proper motion, but some weight may have been added to the belief held by everyone that the faint stars and the Nebula are moving together, or at rest together.

Stars 781 and 793 are the only ones having a yearly proper motions greater than 0".1. Half of those stars having fairly large well determined motions are variables. The motion seems to be mainly around the Trapezium from North to East. It is more likely that these last two phenomena are purely accidental as the number of stars involved, some ten or twelve, is too few to give any weight to general statistics. It is also probably accidental that of those stars having large motions the brighter ones have positive and the fainter negative parallaxes.

Of 66 well determined total motions, 14 are under 0".01, 26 between 0".01 and 0".02, 16 between 0".02 and 0".03, 4 between 0".03 and 0".04 and 6 are greater than 0".04. This would seem to indicate that many of the motions between 0".01 and 0".02 are real, as the proportion is greater in that section than would result

from pure accident. From a consideration of thr results obtained by other observers using other methods it seems unlikely that the results obtained by this instrument could be much improved by any other manner of taking and reducing the plates.

By way of suggestion for future work, more attention should be paid to getting good plates of 2^m exposure, and possibly of 30^s and 10^m in order to connect the bright stars with the faint ones and the Nebula. Coarse grained plates are almost useless for the Nebula. This part of the Thesis was suggested by Professor Leavenworth to whom I am endebted for constant interest and many helpful suggestions.

A large part of the computing was done by Mr. Walter E. Anderson and Miss Helen M. Villars.

It is a pleasure to acknowledge my indebtedness to Astronomer Curtis who took the plates used in Part I.

List of Plates used.

No.		Date	Ex	H.A.	P.F.	AP
			h m	h		
8	1897	Jan 7,	0 2	+1.2	-0.17	Full
15		Feb.24,	1 3	+0.5	+0.85	"
57		Oct.6	1 15	-1.0	+1.00	"
60		Oct.24,	1 10	-1.0	+0.92	"
74	1898	Jan.15,	1 25	-0.2	-0.29	"
195	1908	Feb.20,	0 58	+1.2	-0.81	"
197		Feb.25	1 2	+0.5	-0.86	10"
219	1909	Jan.19,	0 2	-0.5	-0.36	9 1/2
229		Mar.19	1 0	+2.1	-0.98	9 1/2
256	1910	Mar 13,	0 30	+1.2	-0.95	Full

Plate 256 is on Lumière Σ emulsion, the plate is as dense as the average but the points on the Nebula are poorly defined.

No	A	100b	100c	A'	100b'	100c'	Mag	Mag
8	+.0407	+.1083	+.0624	+.1424	-.0580	+.0874	+.0025	+.0025
15	+ 125	+ 351	- 200	+ 305	+ 552	+ 527	+ 8	- 5
57	+ 69	- 4	+ 176	+ 578	- 192	- 274	0	0
60								
74	+ 228	+ 450	- 429	- 438	+ 198	+ 489	- 10	- 8
195	+ 172	+ 308	+ 158	+ 869	+ 278	+ 240	+ 17	+ 12
197	+ 56	+ 723	- 180	+ 1187	+ 344	+ 701	+ 17	+ 17
219	+ 305	+2080	+ 513	+ 1060	- 15	+ 2082	0	0
229	+ 343	+1576	- 549	+ 1020	+ 1262	+ 1310	+ 12	+ 17
256	+ 264	+ 494	- 123	- 1016	+ 549	+ 676	+ 8	0

The reduction has the form

$$a + bx + cy + \text{mag. eqn}(\text{mag}-11) = dx$$

Points on the Nebula.

	Wt	X	Y	μ	μ'
B	2,0	-0.0183	+2.9186	+0.029	+ 0.058
C	10,6	+0.1962	+2.5674	+ .059	+ .002
D	2,6	-0.0256	+2.2509	- .062	+ .010
E	10,6	3.2252	-2.4377	+ .002	+ .008
G	4,12	1.4607	-3.8894	- .048	- .001
H	2,6	2.3201	-3.8711	+ .074	- .002
Pons	4,10	3.2115	-4.1758	- 053	+ .074
K	6,4	2.2679	-4.3866	- 096	+ .085
M	2,6	4.7620	-4.0305	- 047	+ .012
N	2,4	5.6828	-4.2357	+.002	+ .112
O	4,4	4.7514	-5.5345	- 042	+ 044
P	10,4	4.9182	-5.6808	- 088	-.065
R	2,8	4.2553	-5.9726	+ 056	- 023
S	6,8	3.6223	-6.0238	+ 027	- 038
V	14,4	-4.7949	-6.6243	- 001	+ 020

These points are indicated on the accompanying print of the field.

S T A R S .

Bond No	Mag	X	Y	μ	μ'
246	9.0	-24.7099	-18.0927		
427	11.4	13.6692	- 6.0171	-0".005	-0".010
430	12.0	13.6234	- 8.3034	+ 004	+ 8
435	V	13.4178	- 4.2882	+ 2	+ 49
449	108	12.7726	- 0.0094	+ 10	+ 21
458	122	12.3193	- 6.6470	- 13	- 11
467	V	11.7842	-15.8681	+ 17	+ 46
479	107	11.1808	- 0.2919	+ 5	+ 12
490	128	10.9482	- 5.5866	- 4	- 11
497	107	10.4988	-14.7484	- 2	- 23
505	93	9.7388	-11.9535	+ 18	+ 24
506	115	9.6364	- 4.7672	+ 4	- 18
510	V	9.4262	-13.1764	- 5	+ 10
516	128	9.1785	- 5.4188	+ 25	+ 26
523	102	8.5818	- 6.8171	- 1	- 17
524	128	8.6022	- 4.5700	+ 1	+ 2
New 1	137	8.3222	- 5.6506	+ 6 :	- 72:
532	138	8.1044	+ 3.6994	- 18:	- 11:
545	V	7.8100	-11.5773	- 3	+ 14
551	113	7.4119	+ 3.6655	- 13	- 12
New 2	136	7.2340	- 8.8253	—	—
554	82	7.1916	+ 6.2630	+ 17	- 21
558	V	7.2005	- 6.8581	- 13	- 14
566	125	6.3008	-11.5263	+ 8	- 6
567	129	6.1840	- 4.9639	+ 2:	+ 11
570	88	6.1250	- 9.4260	- 8	+ 12
573	123	5.9738	- 7.8270	- 15	+ 17
575	126	5.9430	- 5.2573	- 1	+ 22
580	125	- 5.7845	+ 1.5477	+0".023	+0".025
581	127	5.7328	- 7.5563	- 2	- 24
589	V	5.4860	- 5.2360	—	—
598	124	5.1538	-12.4925	- 1	+ 1
615	V	4.7196	+ 3.5463	+ 11:	- 39:
635	108	4.4017	- 3.2480	- 11	+ 11
641	133	4.3470	- 3.0229	+ 25:	+ 23:
647	123	4.1538	- 5.2524	- 15	- 9
650	124	4.0818	+ 1.9024	+ 4	+ 34
652	123	3.9928	- 2.0439	- 13	+ 2
653	126	3.9751	+ 2.3022	+ 11	+ 25
657	117	3.8717	- 2.1277	- 9	+ 4
663	V	3.6032	- 2.4332	- 5	+ 18
666	125	- 3.5573	- 8.1562	+ 25	+ 5

S T A R S Continued.

Bond No	Mag	X	Y	μ	μ'
669	104	- 3.4662	- 3.2188	+0".004	+0".002
670	113	3.4138	+ 6.3452	- 7	+ 7
671	121	3.3602	- 5.3016	- 1	+ 1
672	V	3.1616	+28.4194		
676	124	3.1811	- 5.4000	—	—
677	133	3.2460	- 8.2310	+ 44:	- 7
681	125	3.0938	- 1.9624	- 6	- 9
685	72	2.8738	- 6.4580	+ 18	+ 11
690	115	2.6009	-12.2978	+ 4	- 26
New 16	V	2.5205	- 6.1560	—	—
700	115	2.1153	+ 3.3494	- 18	+ 8
701	136	2.1531	-11.8474	—	—
705	113	2.0220	+ 5.3222	+ 23	+ 8
707	119	2.0410	- 9.0990	+ 1	- 11
708	77	2.0089	- 6.4991	+ 16:	+ 21
709	V	2.0222	- 7.1508	+ 23	- 2
724	99	1.4928	- 7.8222	- 10	+ 3
732	120	1.0803	-14.3926	- 8	+ 16
734	83	0.8616	+ 2.5278	- 20	- 7
737	133	0.8580	- 0.3815	+ 7	+ 6
741	V	0.7515	- 6.7420	- 21	- 4
742	75	0.6103	+28.4436		
746	102	0.6903	-14.6506	- 10	- 25
747	135	0.4846	-10.5011	+ 2	- 13
750	118	- 0.4620	-12.6726	± 0	- 2
755	137	+ 0.1464	-10.7173	± 0	- 13
757	99	0.2128	+ 6.2482	- 17	+ 9
759	V	0.1711	- 2.8996	+ 70	+ 14
767	134	0.7356	- 8.0740	- 28	- 56:
768	73	0.9477	+27.3467		
778	123	1.5280	- 8.4954	+ 25	- 1
781	103	1.8382	- 1.6406	+ 170	- 8
784	115	1.9082	- 9.6648	- 2	- 2
785	109	2.0184	+ 4.8804	+ 20	- 39
789	134	2.0302	- 9.000	+ 5	± 0
793	123	2.4908	-13.6013	+ 74	- 108
801	V	2.7476	- 9.6176	—	—
808	120	3.1863	+ 1.6315	- 3	+ 9
822	V	4.0297	-10.0195	+ 6	+ 5
832	V	4.4183	-10.2156	+ 23	- 31
843	72	5.0388	-19.1854		
848	91	6.0026	- 3.9114		
905		10.2921	-20.3012		
924	91	+ 13.1950	- 5.8534		

The large proper motions are plotted on the accompanying print of the field. In the above table colum two

contains the mean magnitude found on the plates used. The scale is that of the comparison stars for T Oronis. The other columns are self explanatory. When adash occurs in the column headed"μ" the determination of proper motion was too poor to be included. A colon indicates uncertainty. When nothing is put in the last two columns the star was observed with a view to being used to reduce to R.A. and Decl and no attempt was made to get proper motion.

C O N C L U S I O N S.

The Nebula seems to show a decided selective absorbtion.

The variable stars are blue.

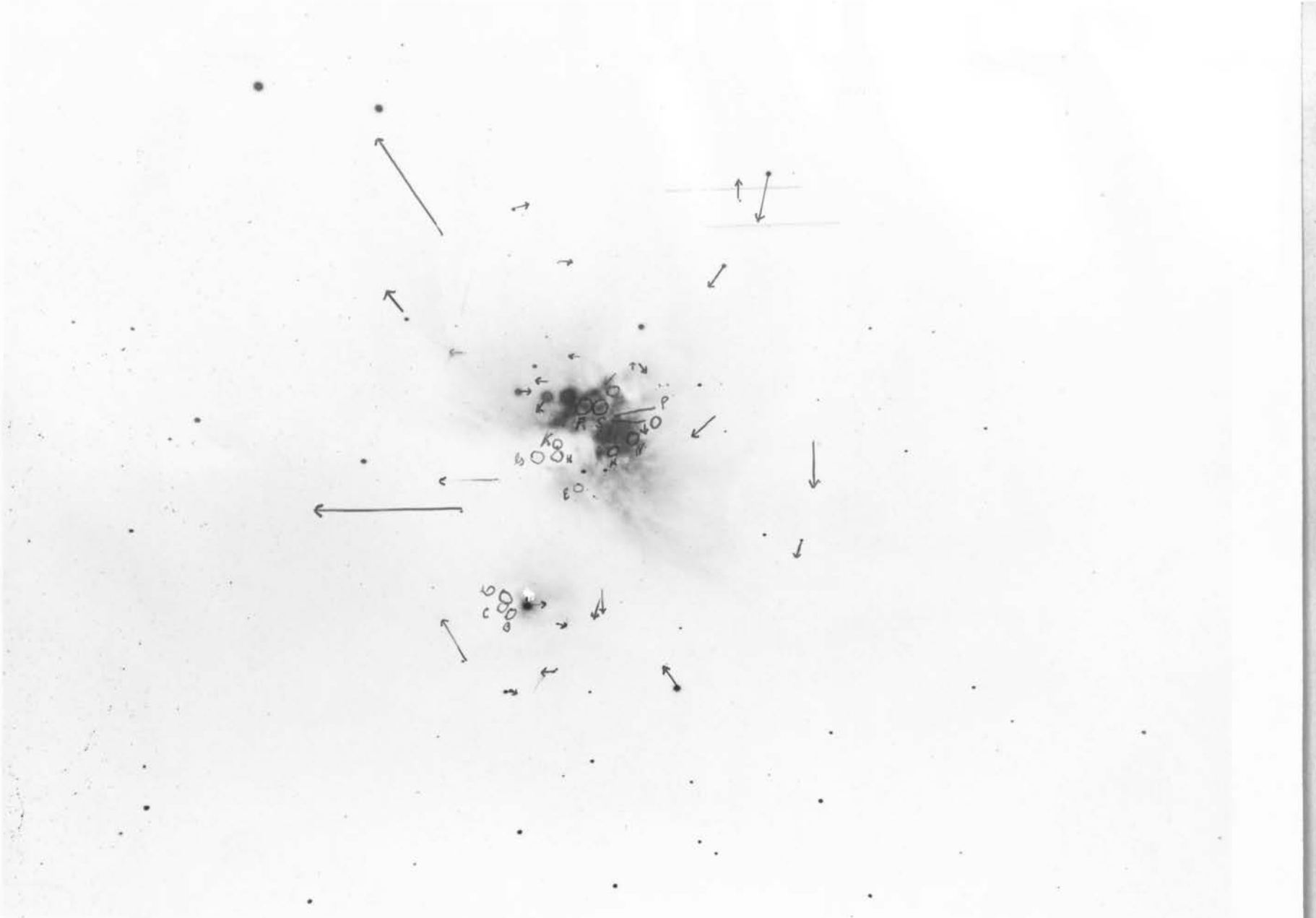
The stars in this region differ very little in color among themselves and probably all, faint as well as bright, belong to the Orion type.

Five stars previously observed at one place were confirmed as variables.

Seven stars, two of which were suspected of variability were found to be certainly variables and five new stars suspected of variability.

Two stars with fairly large motions were discovered.

The greater part of the stars have very small motions. The Nebula is at rest with respect to the stars apparently involved in it.



B. C, D, B, H, K, R. S. are dark spots, next are holes. R and S are interchanged.

In P.M. ½" = 0".08